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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/636,069	04/22/96	SANDHU G	MICR155(95-0

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KIELIN,E	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.	Applicant(s)
08/636,069	Sandhu et al.
Examiner	**Art Unit**
Erik Kielin	2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *May 23, 2001*.

2a) ☐ This action is **FINAL.** 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1, 2, 4-6, 31-36, and 38-54* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1, 2, 4-6, 31-36, and 38-54* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
18) ☐ Interview Summary (PTO-413) Paper No(s). _____
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims **1**, 2, 4-6, **31**, 33-36, 38, **39**-41, **42**, **43**-44, **45-47**, **48**-49, **50** are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 2-050966 (**Hisamune**) in view of U.S. Patent 5,000,113 (**Wang** et al.).

Hisamune clearly discloses Applicant's process, including illuminating ozone and a silicon source gas and optionally a dopant (trimethylphosphate) with a mercury arc lamp to deposit silicon dioxide or doped silicon dioxide onto a wafer surface. **Hisamune** further teaches that the reason for irradiating the inside of the reaction furnace with UV radiation is to induce a photochemical reaction of the gaseous starting materials with ozone (translation, p. 5, lns. 20-21). The apparatus configuration in **Hisamune** (Fig. 1) clearly shows that both the reaction volume and substrate 102 are illuminated by UV lamps 105. **Wang** teaches the carrier gas and similar deposition pressures.

Given that **Hisamune** is clearly illuminating the reaction volume, it is held absent evidence to the contrary, that the reactants are inherently undergoing (1) "heterogeneous chemical reactions," within a chemically reactive distance of the substrate, and (2) the fixed charge is necessarily reduced. In as much as Hisamune uses parameters of temperature and pressure which are clearly as disclosed in Applicant's specification, it would be wholly impossible for the dielectric film produced by Hisamune to *avoid* a reduction in fixed charge --especially since it is the atomic oxygen which Applicant indicates is the means by which the fixed charge is reduced, not the presently claimed temperature and pressure ranges. Otherwise, Applicant's specification must be admittedly not enabled since both temperature and pressure ranges which would not work by Applicant's admission have been disclosed.

Hisamune does not (1) expressly teach a temperature range of "at least 480 C to 700 C"; (2) specifically indicate a pressure range of 200 to 760 during deposition; or (3) specifically state in the Abstract that the functional atomic oxygen would be increased by the light source and thereby reduce the fixed charge in the oxide layer.

Regarding (1) and (2), (and claims 33-35) **Wang** teaches a similar TEOS/ozone process where helium is used as a carrier gas and a pressure range of about 10-200 torr is taught (col. 20, lines 40-49).

Also, it has been held that ranges near the prior art general conditions is *prima facie* obvious absent evidence of unexpected results. See *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996)(claimed ranges of a result effective variable, which do **not** overlap the prior art ranges,

are unpatentable unless they produce a new and unexpected result which is different in **kind** and not merely in degree from the results of the prior art). Applicant's specification indicates deposition parameters including a temperature range of 200-700 C with a preferred of 480 C and a pressure range of 0.1 to 760 torr with 200 torr preferred (specification, page 7) -- not the ranges now claimed: 480-700 C and 200-760 torr. Applicant's specification provides no evidence to indicate unexpected results as required by the precedent in *In re Huang*. Instead, Applicant's specification indicates that Hisamune's temperature is near Applicant's preferred value and Wang's pressure of 200 torr is at Applicant's preferred value.

Hisamune teaches that films may be deposited at temperatures lower than 400° C while still achieving **sufficient** growth rates which does not rule out higher temperatures. Therefore, it would have been obvious to choose the temperature of Applicant's claimed process because Hisamune teaches temperatures near Applicant's and because Hisamune teaches that temperature is related to deposition rate and film density, so that even though lower temperatures may be usable, it would be obvious to increase temperature to provide an even faster deposition rate and more efficient processing which provides a quality silicon oxide film, according to the precedent set by *In re Huang*. Further, Applicant's specification fails to show any criticality to the any temperature range -- especially not the one now claimed -- and has not presented evidence of unexpected reduction of fixed charge of the oxide layer by using either the temperature or the pressure range now claimed, which is different in kind and not degree, as required by the precedent established in *In re Huang*.

Further, it has been held that optimization of result effective variables is obvious. Therefore, it would have been obvious to optimize the pressure and temperature to provide effective oxidation of TEOS to form the film taught by the **Hisamune** reference, according to the precedent set by *In re Aller*. It further would have been obvious to choose Applicant's claimed pressures in the Hisamune process because **Wang** teach a similar process with overlapping pressures, according to the precedent set by *In re Wertheim.*

Also, it would have been obvious to use helium as a carrier gas because **Hisamune** suggests that other carrier gases may be used and because Wang et al. teaches it is well known in the art for use in similar processes.

Since **Hisamune** uses the same light source as Applicant, it is inherent that the functional oxygen concentration would be elevated and therefore have the same effect on reducing the fixed charge as Applicant has recognized. The claiming of a new use, new function or unknown property which is inherently present in the prior art does not necessarily make the claim patentable. See *In re Best*, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977). See also *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the

characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Regarding independent claims 31, 42, 51, 52, Applicant clearly states in the specification,

> "The source of light should be of a high intensity nature and can be supplied by any appropriate source, **preferably** in the present example, an array of mercury arc lamps positioned to uniformly **illuminate the reaction surface of the substrate**." (page 6, lines 3-6)

which indicates that, at best, this unclaimed feature is a matter of design choice --especially since Applicant clearly **prefers** to illuminate the "surface of the substrate" --not just the reaction volume. It would have been obvious to one of ordinary skill in the art at the time the invention was made to illuminate the reaction volume without illuminating the substrate as a matter of design choice because it is known that ozone absorbs UV radiation to for O_2 and active atomic oxygen so that the substrate would not have to be illuminated to achieve the active oxygen. (See the Inoue article, as discussed further below).

Regarding claim 36, the only difference between applicant's claim 36 and the **Hisamune** process is that the exact ozone concentrations are not taught. However, it has been held that optimization of result effective variables is obvious. See *In re Aller* 105 USPQ 233, 255 (C.C.P.A. 1955). Therefore, it would have been obvious to optimize the required ozone concentrations to provide effective oxidation of TEOS to form the film taught by the **Hisamune** reference, according to the precedent set by *In re Aller*.

3. Claims **1**, 2, 4-6, **31**, 33-36, 38, **39**-41, **42**, **43**-44, **45-47**, **48**-49, **50** are rejected under 35 U.S.C. 103(a) as being clearly anticipated by the article by **Inoue** et al. entitled, "Growth of SiO_2 thin film by double-excitation photoinduced chemical vapor deposition incorporated with microwave excitation of oxygen" *Journal of Applied Physics 64*(11), 1 Dec. 1988 in view of **Hisamune** and **Wang**.

Inoue clearly discloses the each of the features of the instant invention including, the reaction volume, the SiO_2 precursor and ozone, heating the substrate to 25-300 C, a pressure of 0.2 Torr, "illumnat[ing] the space just over wafer horizontally" (i.e. the reaction volume) without directly exposing the substrate surface to increase the atomic oxygen concentration which inherently reduces the fixed charge in the SiO_2 layer. (See especially Fig. 1, right-hand column of page 6496 and left-hand column of page 6498.). It is held, absent evidence to the contrary, that the reactant gases are undergoing heterogeneous reactions given that the set up is as described by Applicant. *See* In re Best, 195 USPQ 428 (CCPA 1977) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980).

Inoue does not teach Applicant's claimed temperature range but does teach a range overlapping Applicant's disclosed temperature range of 200-700 (Applicant's specification page 7, line 6). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the temperature to achieve higher deposition rates and a more efficient deposition, as indicated above, and because Applicant has provided no evidence to indicate that the deposition temperature provides unexpected results in reducing the fixed charge in the SiO_2

layer relative to the prior art temperature range. It is especially important that evidence be provided since Applicant discloses and claims that it is the active oxygen generated by exposing the ozone to the UV light source which reduces the fixed charge in the SiO_2 layer and is not due to the temperature range, pressure range, ozone concentration, SiO_2 source gases or carrier gases used, dopants used, etcetera.

Hisamune, as indicated above, teaches a very similar method to **Inoue** and teaches Applicant's dopant and approximate temperature both of which would be obvious to apply to **Inoue** for the reasons indicated in **Hisamune** because forming doped glass, such as BSG, PSG, FSG, BPSG, is highly desired in the art and is also merely a matter of design choice since the dopant is not indicated by Applicant to impact the fixed charge in any way whatsoever. One of ordinary skill could add dopant to the reactant gas mixture as taught by **Hisamune** and have a reasonable expectation of success using the method of **Inoue** to form a doped glass. Alternatively, it would have been obvious to modify **Hisamune** in view of Inoue to use the direction of illumination taught in **Inoue**, for the reasons indicated in **Inoue**.

Inoue does not teach Applicant's pressure range or silicon source, but **Wang** is applied as above.

4. Claims 32, **51**, **52**, are rejected under 35 U.S.C. 103(a) as being unpatentable over either of **Hisamune** and **Inoue** as applied to claim **31** above, and further in view of U.S. Patent 4,287,083 (**McDowell** et al.).

Hisamune and **Inoue** teach that a mercury lamp should be used, but does not specifically teach a mercury arc vapor lamp.

However, **McDowell** teaches that in the coating industry, mercury arc vapor lamps are well known for providing UV radiation.

Therefore, it would have been obvious to one of ordinary skill in the art at time of the invention to apply the teachings of **McDowell** because a mercury lamp is required and **McDowell** teaches that mercury arc vapor lamps work effectively for providing the requisite UV radiation.

5. Claims **1**, 2, 4-10, 41, **43**-44, **45-47**, **48**-49, **50** are rejected under 35 U.S.C. 103(a) as unpatentable over **Hisamune** in view of **Wang** and **Imai** et al. (US 5,633,211) or, alternatively, Inoue in view of **Hisamune**, **Wang,** and **Imai**.

Each of **Hisamune** and **Inoue** clearly teach Applicant's process of illuminating ozone and a silicon source gas with a mercury arc lamp to deposit silicon dioxide onto a wafer surface. **Hisamune** further teaches that the reason for irradiating the inside of the reaction furnace with UV radiation is to induce a photochemical reaction of the gaseous starting materials with ozone (translation, p. 5, lns. 20-21). **Inoue** further teaches that the UV radiation produces active atomic oxygen. The apparatus configuration in **Hisamune** (Fig. 1) clearly shows that both the reaction volume and substrate 102 are illuminated by UV lamps 105. **Inoue** teaches illumination of the space just over the substrate. **Wang** teaches the carrier gas and similar deposition pressures.

Hisamune teaches a phosphorus dopant may be added, but does not teach a second dopant. However, **Imai** teaches that it is conventional to use both boron and phosphorus to form BPSG films which reflow at low temperatures (col. 1, lines 35-42 and col. 2, lines 6-10). Applicant's claimed boron source gases are taught (col. 1, lines 50-60). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to also use a boron source gas to form BPSG to allow reflow at lower temperatures to provide for a more planar surface, as taught by **Imai**. The same applies to Inoue for the addition of either one or two dopants, for the reasons indicated in **Imai**.

Regarding claim 46, the **Hisamune** and Inoue processes do not teach a fluorinated precursor. However, **Imai** teaches that TEOS may be substituted with a fluorinated precursor to provide better flow of the deposited layer (Abstract and col. 5, lines 41-42). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to apply the fluorinated precursor teachings of **Imai** to either of the **Hisamune** or **Inoue** processes for the reasons given by **Imai**. and because doped glasses are highly desired in the art and because the dopant has not been indicated by Applicant to affect the reduction in fixed charge of the resulting glass layer, as above.

6. Claims **53** and **54** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Hisamune** in view of **Wang** and **Imai**, or alternatively, over, Inoue in view of **Hisamune**, **Wang**, and **Imai** as applied to claim **52** above, and further in view of **McDowell** et al.

Hisamune, Inoue, Wang, and **Imai** do not teach a mercury arc vapor lamp.

McDowell et al is applied as above.

Response to Arguments

7. Applicant's arguments filed 12/4/00 have been fully considered but they are not persuasive.

Applicant argues that the claimed temperature range -- amended from 200-700 C to 480-700 -- is different from the prior art. Similarly, in the present amendments, Applicant has added the additional limitation from of a pressure range of 200-760 torr. But the pressure range as originally claimed (claim 37) was 0.1-760 torr. Examiner notes with interest that Applicant appears to have used hindsight reconstruction in claiming the present pressure and temperature ranges, said ranges were only modified after being presented the applied prior art. As noted above, Applicant's specification clearly discloses that the broader ranges are appropriate for the method. It makes it highly unlikely that the ranges --as now claimed-- provide some unexpected benefit or result as required by the precedent established by *In re Aller* and *In re Huang*.

Applicant continues to argue that the pressure range as *now* claimed is "unexpected," but this is not germane to the case law applied since said case law is directed to the results and not to some allegedly unexpected CVD process parameter. Given that the pressure range disclosed and originally claimed runs the entire gamut of pressure ranges used in CVD --low-pressure CVD, sub-atmospheric pressure CVD, and atmospheric pressure CVD-- it is highly unlikely that the

range now claimed provides some unexpected results. **Again, Applicant may overcome the rejections by providing evidence of unexpected results.**

Further in this regard, Applicant's allegation that the pressure and temperature ranges are "unexpected" is merely **conclusory** statement made by Applicant's Representative. Even if the pressures and temperature as presently claimed were "unexpected," which Examiner does not admit to, this indicates nothing of the resulting dielectric film produced. In other words, just because Applicant's Representative alleges that the pressure and temperature ranges are "unexpected," does not constitute *evidence* that the dielectric films produced are any different than those films produced by the same method in the prior art. This is why evidence to distinguish Applicant's invention over the prior art is required, according to the aforementioned precedent. The claiming of a new use, new function or unknown property which is inherently present in the prior art does not necessarily make the claim patentable. See In re Best, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977).

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patent 4,916,091 (Freeman et al.) also teaches a process similar to applicant's claims (see col. 16, ln. 63 to col. 17, ln. 55).

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Bowers, can be reached at (703) 308-2417 or by e-mail at charles.bowers@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724.

EK

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